Memories

By Bob Linton. HO PO RM

My first contact with a Radar set was with A286P at what was to become HMAS *Watson* early in 1943. This set was originally designed to be fitted to aircraft, and had a Yagi antenna. When adapted for ship-borne use in Australian Corvettes, it had a bedstead antenna . This was controlled by an A/S control unit with “M” type transmission. Two operators were situated in the Radar office. One operator reported echoes by use of sound powered telephones or voice pipe to the officer of the watch on the bridge. Such echoes appeared on an “A” scope which was calibrated in thousands of yards, and indicated land (fixed echoes) or aircraft (moving echoes). The other operator kept a log of these reports, and as well, at the beginning of each watch kept a log of the various meter readings such as local oscillator current, crystal current, and transmitter current. These readings could prove useful to the Radio Mechanic if the set broke down. The power supply was adopted from the aircraft alternator of 180 volts 1000 cycles. This alternator was driven by a 220 volts DC motor (standard ship supply). The complete motor alternator assembly was fitted in one of the seamen’s mess decks.

The equipment was fairly reliable, providing it was left in a standby position when not being operated. (See editor’s footnote 1). Most problems were “M” type transmitter problems up in the antenna. This is where I was introduced to crocus paper and carbon tetra chloride. (See editor’s footnote 2). Test equipment was primitive consisting of a locally made “University” brand multimeter, plus a PMG made cathode ray oscilloscope (CRO) which had a power supply unit one could barely lift, and a “Wee Megger”.

At a later date, this A286P was updated to an A286Q with increased power output using “Micro Dog” transmitting valves. The modulator was a spark modulator, quite a sizeable unit, manufactured by H.M.V. (or possibly AWA) in Sydney.

Another set manufactured in Sydney, by AWA Australia, was quite unique in many respects. This was the A276. One of the two engineers responsible for its design and manufacture was named Richardson. The prototype set was installed in lieu of an A271 aboard HMAS *Yandra. Yandra* was despatched to Milne Bay for special duties, and the return journey provided an excellent opportunity to carry out sea trials of the A276. Both the Radar Engineer Lieutenant Bill Boswell and myself assessed its performance and recommended some modifications for production models.

Once again spark modulation was used instead of thyratrons. This was done by attaching 10 tungsten electrodes to the shaft of the motor alternator set in the base of the transmitter cabinet, and one electrode to the assembly frame. The fixed electrode was electrically connected to the magnetron. Each time a moving electrode passed the fixed electrode the pulse line was discharged to the magnetron. As the alternator was 50 cycles and as there were 10 moving electrodes, a pulse repetition frequency (prf) of 500 could be achieved. That is, the A276 Radar would transmit a high power short duration pulse 500 times per second.

The antenna was a parabolic reflector fed by a waveguide horn at the focus. The reflector was made of marine plywood faced with metal, and all housed in a marine plywood lantern fitted to the foremast.

The control of this antenna was another unusual system. It had a motor generator which had various outputs to rotate the array at 5 rpm, 10 rpm and 20

rpm. It also had hand control plus a sector control which was used to sweep backwards and forwards over an echo. Above the “A” scope was a PPI, with another PPI on the bridge.

One interesting feature of manufacture was the modular construction used. For this reason servicing became quite simple by exchanging a faulty unit with a serviceable one, and this meant minimum downtime, especially on the bridge PPI

One of the first production models of the A276 was fitted to HMAS *Glenelg* where I had the job of setting to work in Williamstown dockyard and doing trials on the voyage to Sydney.

Editor’s footnote 1. For equipment to be left in a standby condition meant that the power to the filaments of the thermionic valves was switched on permanently, but the High Tension (HT) was switched off. It was a characteristic of thermionic valves that for longer life and more reliable operation, it was best to delay applying the HT for up to 4 or 5 minutes after applying the power to the valve filaments.

Editor’s footnote 2. Crocus paper was a very fine abrasive paper, and carbon tetra chloride (CTC) was a universal cleaning liquid. Both were used to clean build up of sea salt, grime, grease, oxidation on electrical contacts.

oooOOOooo

Reflections

By Bill Robertson Ch RE RAN

Commencing late 1945, I did my initial training at F.N.D. (HMAS *Cerberu*s) as an Ordinary Seaman, then carried on to the Gunnery School where I qualified as a Radar Control Rating (Third Class). Later I completed another Gunnery School course, complete with the dreaded commando section at the Hann's Inlet Rifle Range. This was followed by the Radar training at H.M.A.S. *Watson*, where we were introduced to mainly Type 285, Type 282, and the Operator's control panels for same, namely Panel L24 for 285, and L22 for 282.

Type 285 and Type 282 had identical Transmitters and Receivers. The main difference was in their Aerial arrays. 285 had five "Pig-Trough" reflectors mounted side by side with two Yagi arrays side by side in each reflector. Each Yagi consisted of one driven dipole and six or seven director dipoles in front. Type 282 had only three Pig-Trough reflectors as it was mounted on a smaller director tower. The signal to and from the driven elements passed through a “beam splitter” arrangement which was motor driven and incorporated a “Maltese Cross” mechanism which gave a small phase shift to the centre dipole cluster. This shifted the beam slightly from side to side, so that only a target which was in the very narrow overlap area of the two transmitted lobes would return equal strength signals from each lobe.

The C.R.T. "A" scan in front of the operator had a small shift applied to it which shifted the displayed echo from the right lobe to the right on the display so the echoes appeared side by side with a slight overlap. The two echoes from the same target then gave the operator the clue of which way the aerial had to be turned to line up the target to within half a degree of the centreline of the aerial. The rule was, train the Director (on which the Aerial was mounted) toward the weakest echo. The "A" Scan was an Admiralty pattern watertight rectangular box

designed, so I believe, to take a direct hit from a 15 inch shell, and was heavier than I care to remember. The A scan was of course painted blue, and was mounted in the director tower immediately in front of the Trainer, positioned so it was almost impossible to access for servicing.

The Trainer knew which of the echoes on his screen was the one he was supposed to be concentrating on because the operator of the L24 / L22 panel in the Gunnery Control Centre had positioned a strobe over the echo on his screen (from which he was passing range of target information to the guns) and this also brightened the echo at that range on the trainer's display.
A well trained operator could also monitor the splashes from the shells which missed the target (most of them!) and call the "fall of shot" to the Gunnery Officer, as he could clearly see if they were ‘over’, ‘short’, ‘left’, or ‘right’ .

After a practical course on H.M.A.S. *Murchison* I became a second class RC rating, crossed guns on right arm and all! That was when I saw the light, and shortly afterward I was on my way to H.M.A.S *Torrens* to join the exalted ranks of the R.A.N. Radio Mechanics. On completion of training at "*Torrens*" it was back to "*Watson*" for me. There I was introduced to the mysteries of A276, A286, 285 with which I had some previous non technical experience, Air warning Type 79 and 281, Type 277, and Type 293. We also covered Loran and a 10 cm Radar jamming device which I am pleased to say I never saw again.

At the end of that course I was posted to H.M.A.S. *Shoalhaven*, a River class Frigate, sister ship to *Murchison*, so I had a pretty good idea of what Radar I would find aboard. These were:

Air	Warning	A286
Surface	Warning	A276
Gunnery	Control	285
IFF	242	
A286	A scan display only.	
A276	A scan display and AWA PPI in Radar Office	
	Remote AWA PPI on the Bridge	
	Admiralty type PPI in Operations room	
285	A scan in Radar Office	
	L 24 Panel in Transmitting Station (A scan)	
	A scan in Director Control Tower.	

Two years later nothing had changed except that we had replaced the A scan in the director control tower with a much lighter unit which fitted over the Trainer's binoculars and allowed a 1 inch A scan to be viewed through the right lens when required.

One of the problems with Type 285 was with moisture finding its way into the beam-switching unit and the inch diameter cables, some rigid lead covered, some flexible, which fitted into the device. Regular insulation tests gave warning when these cables had to be removed and dried. The unit itself more often than not also had to be dried out. When all was dry the whole lot had to be re-assembled, the connecting glands packed with lead wool, and tightened up. My offsider, Bill Grant and I were nearly finished this operation one day when it started to rain. To save a couple of day's hard work I sent Bill down to the Sickbay to see the Sickbay Attendant for a handful of condoms which we placed over the ends of the cables and over the connecting glands. About an hour later the Captain sent for me to report to him on the bridge. Pointing to our recently fitted protective coatings he asked me if what he was pointing at was what he thought it was. I explained the situation and emphasised that this was a short term measure which had proved highly effective in keeping everything bone dry. His reply was that our initiative

was highly commendable, but as we were entering harbour at first light the following morning I had better start praying for the rain to cease so that we could finish the job, as if he found things looking the same the next morning he would personally place the offending objects where the sun would never shine on them again. I assured him that the message had been received loud and clear. Never had two R.E.s worked so fast when the rain stopped.

Back to "Watson" for an extended stay. I think it was one week! Then it was H.M.A.S. *Hobart*.
Hobart had one Type 285, one Type 284, must have been six Type 282, one 277, one 293, one 281 and a brace of IFFs. At one time the 284 was due to be replaced by 274. The gigantic parabolic cheese type 10 cm antenna arrived, but that is as far as it got. The antenna was never fitted to the director, and as far as I can remember the electronics never materialised.

All the equipment and displays were standard Admiralty pattern. The one unusual item was in the plotting room. This was a Skiatron. This was a PPI with a high intensity tube which painted echoes a violet colour. The picture on the tube face was projected onto a plotting table from below, via a front silvered mirror, enabling plots to be made directly on the table. I have good reason to remember some of the gear on Hobart as eventually I wrote out the return notes Form AS 331 for every single item on the Electrical Officer's Establishment list and returned the lot to Leichhardt Stores.

By now it was time for another trip to "*Watson*" for a Radar to W/T conversion course. This was to bring us uneducated Radar types into the world of wireless telegraphy. Who the "powers that be" thought had been servicing all the W/T gear on the ships we had been on still leaves me wondering.
We were also brought up to date on Radar type 960 and a few other things. Now that 1 was "full bottle" on all the latest equipment I was posted to a ship where all this new knowledge could be put to good use, H.M.A.S. *Cowra*.

Cowra was a minesweeper, fitted with A276 and nothing much else. I think the radio gear was left over from World War 1. To add insult to injury the ship had been paid off a couple of years before and had been in a state of preservation..... or rather it SHOULD have been in a state of preservation! In truth it was in a state! Some dingbat who shall remain anonymous had used trays of Calcium Chlorate in lieu of Silica Gel to dehumidify the sealed Radio and Radar offices.

Anything which was made of copper and was not plated in some way had stalactites of green corrosion hanging off it. This made tuning the old AWA W/T Transmitter an interesting experience. Strangely the Radar gear was not badly affected. I eventually stripped the AT13C HF Transmitter down completely whilst in dry dock at Williamstown and had every piece of metal in it silver-plated. After that all was well! Our 500 kHz emergency transmitter incidentally was of the spark-gap type, and the emergency receiver was a crystal set! After twelve months on "*COWRA*" I was transferred to "*BATAAN*", one of the three TRIBAL class destroyers built at Cockatoo Docks in Sydney Harbour.

BATAAN was not fitted with the most modern Radar either! The surface warning Radar was an American set S.G. (SUGAR GEORGE). The Long range warning set was S.C. (SUGAR CHARLIE). There was also an I.F.F. set type B.N.. S.G. had an A scan in the Radar Office. This was later supplemented by a PPI display (which I wired up as a "HOT SPARE" quite illegally), as the Display unit on the open Bridge tended to become temperamental when salt water leaked in through the top panel and dribbled over the components. The approach to repairing this particular piece of electronics was somewhat unusual. When the unit was removed from its housing and taken below, still with salt water dripping from it, it was taken

directly to the P.O.'s bathroom where it was placed under a warm shower and thoroughly rinsed out to remove any salt. After a couple of days in the Radar office to dry out it usually worked when switched on without any problems other than the odd resistor burning out once in a while. The thought of what this might be doing to the bearings in the deflection coil assembly worried me for a while until I discovered that the bearings were made of GLASS. I had not seen this before nor have I seen it since. It certainly overcame the strange effect caused when steel deflection coil bearings became magnetised and caused echoes to jitter about on the display as the trace rotated.

S.G. also had a PPI in the Operations Room. S.C had a larger PPI in the Operations room and must have had an A scan somewhere near the receiver which was in an annex off the Ops room but I have no recollection of it whatever. The BN interrogator/ IFF was also in the annex.

The Type 285 was in the Radar office with the SUGAR GEORGE. There was an A scanning in the Office, an L24 panel in the T.S. and an A scan in the Director control tower. BATAAN was later refitted with Air warning type 293 in lieu of S.C. and a Commercial 3cm surface warning set in lieu of S.G.

On sea trials following this refit we had an interesting experience with a complete failure of all the new equipment. We had carried out an emergency full-astern exercise with a following breeze.
When trouble shooting we found that there were multiple earths on cables which ran up the aft end of the lattice mast. A post-mortem on these cables showed that the heat from the exhaust gases from the forward funnel had melted the polythene insulation inside the co-axial cables, the heat had caused the inner conductor to expand and to contact the outer conductor causing the short-circuit. The polythene had then set when it cooled leaving the conductors in this shorted state. We had a quick trip to Williamstown dockyard to have all the affected cables renewed and an asbestos deflector plate fitted to the cable trays.

I encountered one most peculiar problem with 285 on BATAAN, thanks to Garden Island Dockyard. The receiver tuned up pretty well before we left the Island after a minor refit. There were echoes every where from the land, and it was not until we cleared the heads that I ventured up to the Director Control Tower to check the display up there, and found that something was amiss.

I trained the aerial on a passing ship and received no echo! It was some time before I found that a very good echo of the passing ship could be obtained by training about 30 degrees either side of it. Quite some time later whilst sitting on top of the Yagi array I noticed that the Part Number of the dipole assemblies could be seen on the upper part of all except the two central units.
Whilst I had been on leave, unknown to me Dockyard had replaced all the dipole units carefully installing the two central units upside down. This produced two transmitted lobes about 60 degrees apart, each nicely beam-switched As a result it was possible to obtain a very accurate bearing on a target which was actually at 30 degrees to the direction the aerial was pointing. This took about two minutes to rectify but I confess to taking a bit longer to find what was going on.

You may be aware that *BATAAN* and *VENGEANCE* had a collision a couple of hundred nautical miles North West of Darwin whilst we were refueling from the carrier after escorting the Queen (in the *GOTHIC)* from Fremantle on her way home after a royal visit. After *BATAAN* managed to disengage from this dingle we were minus a few feet of the bow and the upper-deck superstructure on the Port side
had suffered some unsolicited panel-beating. There were also some other strange things which were duly reported in our damage report but quite how significant they were not appreciated at the time. The duty operators of the 293 reported

having to shut down the transmitter due to loud arcing and sparking from the waveguide in the Radar room. This was found to be caused by the normal 3/16 inch gap in the waveguide at the transmitter end having closed up. Some force and readjustment of mounting hardware was required to restore the gap. All the main radio aerial leads had to be lowered to the deck and shortened by about a foot or more as they had stretched, and were obviously sagging. The next time we were in dry dock it was found that the keel was twisted. That could not be rectified and *BATAAN* was paid off.

For some strange reason I thought that a draft to my Home Port would be in order but that was not to be. Just so that I would not get to like the feel of dry land Navy Board sent me to HMAS *PLATYPUS* for the ten days I had to wait for HMAS *SYDNEY* to berth.

Sydney was fitted with Type 960 long range Air warning Radar, Two type 277 close range Air warning sets, one forward and one aft of the island. One type 293 and one commercial 3cm surface warning (of the same type fitted to *BATAAN* and whose number I have forgotten) There was also an air branch maintained C.C.A. (Carrier Controlled Approach) Radar mounted aft.

Our own close range Radar proved far more effective for controlling aircraft landings and the CCA set was removed. We had one STAAG mounting Twin 40 mm AA controlled by Radar type 262.
Most of the displays from these Radars were mounted in two adjoining rooms, the names of which escape me for some reason. These rooms were the only part of the ship which had really good air-conditioning. On a couple of occasions in the tropics the air-conditioning broke down. Some bright spark each time opened the outside doors to let some fresh air in. Probably for some selfish reason he thought he should be allowed to breathe. Lovely cold PPI s, lovely humid air, lovely high voltages lots of lovely condensation. Loud bangs, sparks, smoke and a Chief RE with at one time twelve unserviceable PPI s within five minutes. This is not a good feeling.

When *SYDNEY* went into refit to become a troop transport I was sent at last to my Home Port to serve out my last two years. Was I, Like hell I was! It was off to The L school at FND to lecture on Auto Acquisition Fire Control Radar! If you would like to know how Conical Scanning is achieved or how the Radar controls the hydraulics of a STAAG mounting to search for and lock on to a target and track it just ask me. It will take another page or two. Perhaps some other time.

oooOOOooo

H.M.A.S. Napier

By Tom Chapman. HO PO RM

Early during WW2, eight “N” class destroyers were built in the UK, and 5 of these were manned mainly by R.A.N. personnel. Most of these ships were fitted with surface warning and gun fire control Radars. Photographs of the time show a mast top aerial and a 285 type aerial above the visual rangefinder.

In the 1944-45 period, *Napier* had a type 271 Radar fitted. This was a 10 centimetre surface warning Radar and it replaced the visual rangefinder. The Radar office was abaft the director and had a timber and perspex dome above. This dome housed two aerials and the transmitter. Aerial rotation was via a drive shaft manually controlled by the Radar operator through 360 degrees with a slight overlap astern. The display was an “A” scan, and this together with two operators completely filled the Radar office. Details of echos were passed to the bridge by voicepipe or by phone. A small office two decks below housed the L17

panel accurate range measurer. From here, ranges were passed verbally to the Gunners Mate by phone for the purpose of fire control.

As well in this period 1944-45, *Napier* had a type 291 combined surface and air warning Radar. The antenna was at the top of the foremast, and was hand driven by a Bowden cable under the control of the Radar operator. Display was an “A” scope and was located with the remainder of the 291 equipment in an office off the flag deck. This set was linked to the L17 if accurate ranges were needed. Contact with the bridge was all verbal by voicepipe or phone. In this office off the flag deck was also located the IFF type 253 and the controls for the Radar power supplies. These supplies were two 180 volt 500 cps generators in “A” boiler room.

During September 1944 the type 271 Radar was replaced by a new and more efficient type 271. The interrogator 253 antenna rotated with the 271 antenna. A PPI display was installed in the Plot room, but had limited value as the 271 aerial was not continuously rotating.

The US built Radar type SG (Sugar George) was fitted early in 1945. Its power supply and some of SG’s units were fitted below the Pom Pom mounting. The remainder of the displays and antenna controls were fitted in the Plot room. The antenna was fitted high on the foremast. Sweeps could be all round or sector at various speeds, a big improvement on the old hand drives. There was also a small PPI installed on the bridge.

Napier was flotilla leader, and carried two Radio Mechanics. Presumably the “spare” RM would be transferred to a ship in need of service or whose own RM had come to grief.

oooOOOooo

Radar Equipment HMAS *Shropshire*

By Lieut (Sp) R. Slatyer R.A.N.V.R. Radar Technical Officer, HMAS *Shropshire* October 1943 to January 1946

When *“Shropshire”* was being prepared in England for handing over to the R.A.N. in 1942/43, she was fitted out with a full complement of the current R.N. equipment. The following list of equipment in numerical order of type number includes other equipment installed later.

Type 273. SURFACE WARNING. Wavelength 10 cm (Frequency 3,000 Megacycles). Located just forward of the after control position. Antenna gyrostabilised, located in a “lantern” structure directly on top of office. Also connected to an accurate range display panel in the T.S.

Type 277. AIRCRAFT TRACKING. Wavelength 10 cm. fitted during a refit in mid 1945. Antenna on foremast. Office in new extension on port side of bridge structure. Single “dish” antenna controlled for both elevation and bearing enabled this equipment to provide information on the exact location of an aircraft.

Type 281. AIR WARNING. Frequency 90 megacycles. Transmitting antenna on mainmast with transmitter in office at base of the mast. Receiving antenna on foremast with receiving office on flag deck at base of mast. Antennas rotated in synchronism. The 281 was undoubtedly Shropshire’s most important radar unit! More on this later.

Type 282. For control of multiple pom poms, one set for port and one for starboard.

Type 283. AUTO BARRAGE UNITS. One for each turret. Each set had a control station with display unit on the upper deck. Main office below decks. The purpose of these sets was to enable efficient use of the main armament against dive bombers. We found them quite useful when there were Kamikazes around.

Each of these sets was equipped with a small fire control device – a sort of mechanical computer. When the main armament guns were loaded with shells fitted with a time fuse, generally set for a different time in each barrel, this device would calculate the correct time and fire the gun so that the point at which the shell exploded was the point at which the aircraft would be if it continued on the same course and speed.

Type 284. GUNNERY CONTROL MAIN ARMAMENT. Antenna mounted on the main armament director. Office below decks, accurate range display panel in the TS provided range and bearing for main armament fire control.

Type 285. 4 INCH ANTI-AIRCRAFT GUNS Antenna mounted on after director – high angle control position. Office below decks. Provided range and bearing for anti-aircraft fire control.

Power supplies to all of the gunnery control radars were combined in an integrated system. All sets operated at the same frequency, around 600 Megacycles. Power was supplied from a large motor alternator set with output 180 volts at 500 cycles, which was their pulse repetition frequency, and interference was avoided by having a phase difference between the power supplied to each set

Type SG. An American unit of 10 cm wavelength fitted soon after we joined the 7th Fleet. Antenna on foremast, PPI display in plot below bridge. Used for surface navigation as well as surface warning.

RADAR COUNTER MEASURES. Equipment consisted of multi-band receivers and a type 91 jamming transmitter.

CAPABILITY REPORT

During service in the New Guinea and Philippines campaigns HMAS *Shropshire* achieved a reputation for, among other things, the efficiency of reporting of aircraft movements (Editor's note, see appendix below). I will attempt to explain, briefly, how I consider this was achieved.

This efficiency was due to a combination of:-

The nature of the equipment
Maintenance and tuning
Skill of the operators
Efficiency of the plotting office
Team work

Nature of the equipment. The primary air warning radar was Type 281. This was a rugged piece of equipment built in the style of the R.N. long range W/T sets. The output stage of the transmitter gave an impression of power with quartz "tubes" about 12 cm. in diameter and 40 cm. long.

The transmitting antenna was on the mainmast and the receiving antennas on the foremast. They were broadside style arrays with timber frame, ceramic

insulators, and aluminum dipoles. The feeder for the transmitter was of twin wires held apart by plastic insulators. The receiver feeder was “Protean”

On the flag deck at the base of the foremast was the receiving office. In this were all components of the receiver, including the display and the controller for rotation of the antennas as well as the telephones.

Maintenance and tuning. Because of wartime shortages in England, the materials used for the construction of exposed parts were not always as durable as they could have been. This factor, added to the severity of the tropical conditions in which we were operating, resulted in the need for frequent maintenance work to maintain peak performance. Careful attention was given to this, which included much masthead work, varnishing woodwork and cleaning insulators – even on one occasion, at night in the tail end of a typhoon, to wash off salt spray which was causing sparking while the ship was darkened.

As regards tuning, one feature of the 281 was that most units where tuning was was critical were designed so that they could be tuned to maximise performance. This is different from many other radars where such units are preset and changes over time can adversely affect performance.

Skill of the operators. The display was a cathode ray tube about 15 cm in diameter, known as an “A” scan. (Editors note: See description of “A” scan in the chapter “Radar Basics”). The operator had control of the rotation of the antennas, which rotated in synchronism, and he would adjust the angle of the antennas relative to the fore and aft line of the ship to maximise the “pip” and find the bearing of the aircraft. Some refinements in technique would provide an estimate of the height of the aircraft.

This information would be telephoned to the Plotting Office.

To accurately maintain reports on a number of aircraft on this type of equipment required a great deal of skill on the part of the operator. There would be two operators on watch and they would relieve each other from time to time. *Shropshire* was fortunate in having a number of men with this ability.

Efficiency of the Plotting Office. As well as receiving the reports of aircraft detected by the ship’s radar this office was in communication with other ships in the fleet, friendly aircraft and shore bases. Reports of aircraft positions were plotted on a large board. At times a great deal of information was processed and personnel became very skilled. The officer in charge was of a temperament well suited to his position. *Shropshire’s* callsign was “PORTHOLE” and this name became famous as a source of information on warnings of hostile aircraft.

Team work. As with all operations in a fighting ship the overall efficiency depended on team work. In *Shropshire* there had been very few changes in personnel and all members of the ship’s company had learnt to work together.

This undoubtedly was an important factor in all operations. Perhaps the reports that she was a “Lucky Ship” also had some validity.

Appendix

Extract from “Royal Australian Navy 1942 – 1945” by G Herman Gill. Quote from Leyte Nov – Dec 1944 page 536 “*The American destroyer Ammen referred to the superb Radar telling performed so steadily and reliably by the Shropshire during the operations against the enemy just completed. The information provided by Porthole (Shropshire’s communication designation) was of inestimable value in maintaining the Ammen alert and ready to deal with the Nips at all times”*

Further, in a letter to Captain Nicholls, Admiral Weyler remarked that "*Commander Task Group 77.1 concurs that Shropshire's performance in radar telling was outstanding and takes this opportunity to congratulate her Commanding Officer, and all officers and men who contributed thereto. As a matter of fact Shropshire's excellent performance in subject matter has heretofore been attested in reports submitted to Superior Command.*

As well, pages 182 and 183 of Stan Nicholls book "HMAS *Shropshire*", published by the Naval Historical Society of Australia December 1989 (ISBN 0 958 7456 2) quotes a number of high commendatory remarks about *Shropshire's* radar efficiency, made by senior officers of the USN, & RN.

oooOOOooo

HMAS Sydney

Written by Cherub Log from material provided by PO RE Gordon Wood

Gordon Wood was one of the first Radio Mechanics to graduate from the Adelaide School of Mines RAN training program in August 1946. Following advanced training at HMAS *Watson,* Gordon later was a student at HMS *Collingwood* and HMS *Mercury* in the UK for all of May and June 1947, training to be part of the crew of Australia's aircraft carrier acquisition, HMAS *Sydney*. It was here he studied Radar types 262, 276, 277, 293Q and 960, as well as type 242M Interrogator. What follows are some verbatim extracts taken from Gordon's hand written course notes.

The A276 has been designed as a high power surface and air warning set operating on the "S" band (3,000 Mcs). It operates from 220 volt DC mains and is complete with its own motor alternator unit which supplies 180 volts 500 cycles. Peak power is 400 Kw, PRF is 500 cps, pulse length is 1.0 µsecond. The display equipment is 1 "A" scan and up to 3 PPIs. The "A" scan ranges are 35,000 and 140,000 yards.

The transmitter employs a magnetron type AV16 as Tx valve and is provided with a waveguide output. The aerial consists of a sliced parabaloid fitted with waveguide horn feed. The aerial is capable of 3 modes of operation. One is continuous rotation in either direction at speeds of up to 10 rpm. A second is manual training with gyro stabilisation in azimuth of the true bearing. The third is a sector of variable width between approximately 10º and 80º with gyro stabilisation in azimuth of the mean bearing of the sector.

The Type AUJ aerial has narrow horizontal beam and moderately wide vertical beam. Hand driven in both directions or continuous in one direction. Stabilised in azimuth, i.e. when rotating it does so at constant angular speed relative to the space around the ship regardless of the ship turning or stopping, or if stopped on a particular bearing it will be kept on that compass bearing, Because of the moderately wide vertical beam, vertical stabilisation is not necessary.

The 293. Aerial type AUR. Similar to 276 and designed as target indicator to detect high flying aircraft. Efficiency in horizontal plane not as good as 276.

The 277. Aerial type AUK. Narrow beam in both planes and moves vertically as well as in azimuth. Can be rotated at power at variable speeds in either direction. Stabilised in azimuth and vertical plane enabling angle of sight of aircraft to be found using HPI or by controlling the vertical movement for maximum echo on the normal scan and reading aerial elevation. An interrogator 242 forms part of the equipment. There are 3 types of indicators, the PPI, HPI

and TPI. The TPI is a normal type of PPI but has cursors projected optically on to the screen so that target bearings may be transmitted away to gun control positions or other Radar sets.

The Range Transmission Unit (RTU52) is fitted and enables the range of an echo indicated on the normal scan to be passed to various parts of the ship by lining up a bright spot on the scan with the echo.

The Sector Selector Unit and panel can observe on the normal scan all echos in a chosen arc of bearing whilst the aerial rotates continuously. Echos brighten when the aerial passes through the bearing.

The 293Q. 10 cms. Identical to the 277Q except for aerial and aerial control unit. This has a cheese type aerial tilted to give close range surface cover and air cover up to 35,000 feet. Used as target indicator set but provides all round low and medium air and surface warning when 277 is height finding. 293Q differs from 293P in having a larger cheese aerial.

277Q 10 cms. Warning of low flying and surface craft. Also accurate height finding.

The 262 was designed for control of close range weapons, and supercedes the 282. The STAGG (Stabilised Tachometric Anti Aircraft Guns) was the first type of 262 and consists of Bofors in a twin 40 mm mounting having the Radar set mounted in cubicles on the gun platform. CRBFD (Close Range Blind Fire Detector) is similar to STAGG but having its Radar set in cubicles and the tach box mounted in a director with a completely separate gun platform. The director contains a dome analyser (dummy gun). Present policy is to control one Bofors mounting with one director

Frequency is 10,000 Mcs. PRF is 1,500.Pulse length is 0.5µsecond. Maximum range to lock on to a twin engine aircraft is 7,000 yards.

To give a feel for the complexity of the 262 circuitry, what follows is a summary list of the major sub assemblies:

Long Tailed Pair. Used mainly as a signal amplifier, the objective being to obtain a balanced output from unbalanced input.
Differential Amplifier. Objective is to obtain high amplification from nay slight difference in the input potential to the grids.
Resistance Modulator. Purpose is to produce an AC voltage of fixed frequency and whose amplitude depends on the amplitude of applied DC.
Miller Retainer, Miller Transitron, Resonant Charger, Range Saw tooth Generator, Strobe Firing Flip Flop. These were all special circuits designed to give particular wave forms such as square waves and saw tooth waves.

Some of the special circuits and units were:

Modulator, Triggering Valve, Switching Valve, Head Amplifier with AFC (Automatic Frequency Control), Differential Detector, Radiation Meter, Strobe Amplifier, X.C.O Magslip, T.B.I System, Radial Line Producer, Strobe Positioning Circuits, Strobe Generators, Range Voltage Generator, Signal Measuring Strobe Rectifier, Locking Flip Flop, Suppression Delay Line, Rate Memory Circuit, Magnetic Brake Circuitry, Servo Unit, Limiter Unit, Phase Discriminators

The Rectifier Unit was designed to provide different high tension DC voltages for operation of various units. The initial supply to the rectifier was 80 volts 500 cps,

and the DC outputs were +500volts, +300 volts, +200 volts, -150 volts and -2,250 volts.

oooOOOooo

Yarra III

The time frame of this story is some 6 years after the arbitrary cut off “history date” of 1955, but it was considered to be of likely interest level to readers.

By Chief RE Ray Brown

HMA Ships *Yarra* and *Parramatt*a were among the first RAN ships to be fitted with the powerful new Dutch made Long Range Air Warning Radar, type LWO 2, when these ships were commissioned in 1961, LWO 2 had an exceptionally large Radar aerial, which was fitted to the very top of the foremast on both ships. This caused the ships to ‘roll on wet grass”. On later ships, the aerial was installed much lower to improve stability.

With such a powerful Radar, it was not realised what the ramifications would be when we ‘let it loose on the unsuspecting populace’. To date there had been no negative or positive feedback from the public about Radar testing and use. This was about to change. Following are some of the complaints received.

* The Gore Hill ABC studios: Radars upsetting the recording facilities
* RAAF: LWO 2 Radars had disrupted one of the RAAF’s major exercises when Yarra & Parramatta were operating off the mid northern NSW coast.
* Crew: Scared hell out of sailors when there was terrific noise generated by much arcing and sparking in the waveguide run from the transmitter to the aerial.
* Newspapers: Navy ‘death ray’ fears. Strange beams of light at night. Budgerigars going crazy, telephones ringing, nosebleeds and spine tingling. Electrical appliances at a Wooloomooloo community centre ‘acting strangely’. This story backed up by a soccer star who said Radar testing affected his hi-fi equipment and set off as many as 3 car alarms simultaneously.
* Independent MP Clover Moore used the publicity to champion the cause for those believing in death rays. In a letter to the Defence minister Kim Beazley, Clover Moore stated that the Navy freely emits millions of megawatts of focused pulse-powered radio energy, which slams straight through brickwork of residential building and human tissue. Moore also reported being told by a dockyard employee that when the Radar was tested during the day, data in the Defence Force Credit Union computer was erased. In another letter to Defence minister Beazley, Moore claimed that memories of VCRs, phones and remote control answering machines were being wiped.
* Other complaints included interruption to TV and radio reception, car and indoor alarms being activated.

A Navy spokesman admitted that some Radar transmissions did interfere with some electrical and electronic appliances, and that to minimise inconvenience, test transmissions would be carried out between midnight and dawn, specifically to eliminate interference with Channel 2 ABC transmissions. As well, the dummy load facility was invoked, which almost entirely stopped external transmission.

oooOOOooo

R.A.N Aviation Radar

By Cherub Log & “Skip” Distance

The two eras of R.A.N. aircraft in operational use up to the mid 1950s were firstly the Hawker Sea Fury and the Fairey Firefly 5 & 6, both piston engine driven, and secondly the De Haviland Sea Venom Mk 53, and the Fairey Gannet. The Venom was powered by a centrifugal flow turbojet engine. The Gannet had a double Mamba 100 gas turbine engine driving contra-rotating co-axial four bladed propellers. The double Mamba was basically two side-by-side propeller turbine engines, each driving one propeller through independent gear trains. The port engine drove the front propeller. Both engines were necessary to launch this aircraft, but once airborne it could cruise comfortably on one engine only.

The Sea Fury was a single seater fighter aircraft, with no radar fitted. The Firefly was a fighter bomber and carried a crew of two, viz pilot and observer seated in separate cockpits, the observer being astern of the pilot. The observer had control of the AN/APS IV “Ash Bomb” radar. The complete transmitter, receiver and antenna assembly was housed in a nacelle which was fitted to the underside of the aircraft’s port mainplane (wing), and which looked like a long range fuel drop tank or a large bomb. Control panel and modified “A” scan display were fitted in the observer’s cockpit.

Operating frequency of the “Ash Bomb” was 10,000 Mcs using a cavity magnetron transmitter and klystron local oscillator. Intermediate frequency was 9 Mcs. Maximum range was 100 nautical miles at 10,000 feet altitude. The antenna dish reflector oscillated port to starboard 40 degrees from dead ahead at a rate of one complete sweep every 1.5 seconds. Thus the operator had a continuous 80 degree sweep ahead of the aircraft.

Firefly AS 5 and AS 6 were used to good effect operating from HMAS Sydney during her two Korean War tours. The last Firefly AS 6 was phased out of service in 1955.

The Sea Venom came into service with the R.A.N. in 1955 and was phased out of service in 1963. Unlike the Sea Fury which the Venom replaced, this fighter aircraft carried a crew of two, viz pilot and observer seated side by side. Behind a perspex dome which was the nose of the aircraft the transmitter, receiver and antenna assembly of the air intercept radar type AI 17 (ARI 5807) was fitted. AI 17 operated at 3,000 Mcs. The antenna was a sector sweep dish.

The primary role of the Gannet was anti submarine warfare. The search radar fitted was the AS Mk 19B. This radar operated in the 3 centimetre band (10,000 Mcs), generated from a power klystron. The transmitter, receiver and antenna assembly were fitted in a radome housed beneath the aircraft’s belly. When operational, the observer would cause the nacelle to lower some 120 centimetres below the aircraft’s fuselage. This would allow unobstructed transmissions and receptions for a full 360 degrees of antenna continuous rotation, or selected sector sweep. For the history of the development of ASV Mk 19B, see the separate article “ASV Mk 19B” by Chris Poole.

The Gannet carried a crew of 3, viz pilot, observer and crewman seated in separate in-line cockpits. Both observer and crewman could operate the Mk 19B radar , each having his own control unit and PPI display

oooOOOooo

AI Mk 17 Radar System in Sea Venom FAW Mk 53 RAN Aircraft - Trials and Tribulations

Author: John S. Saywell OAM

Background
The AI Mk 17 Radar was developed as an airborne Radar aircraft installation for fighter aircraft to provide aircrew with target acquisition information under adverse flying conditions, such as cloud, rain or night flying when it was not possible to obtain visual contact with targets, i.e. it was a “blind firing” radar!. The principal targets considered were enemy aircraft.

A succession of Air Intercept Radars had been produced in the United Kingdom for use in RAF & RN fighter aircraft, each new development having better performance & more operating features than the previous version. In the early 1950s, AI Mk 17 Radar was in its design/development phase & this was the Air Intercept Radar chosen by the Royal Australian Navy to be fitted in its new jet fighter aircraft – the Sea Venom FAW Mk 53 for operation from the soon to be acquired angled deck aircraft carrier, HMAS Melbourne, then being built at Barrow-in-Furness, Lancashire, England.

Design Authority
The Design Authority for the AI Mk17 Radar equipment was the Royal Radar Establishment located at Malvern, Worcestershire, England.

Users
Whilst the AI Mk 17 Radar was under development, there emerged two main user groups for the equipment – they were the Royal Air Force & the Royal Australian Navy. The Royal Air Force intended the Radar to be fitted to the first 300 of the Gloster Javelin All Weather Interceptor Fighter Aircraft whilst the Royal Australian Navy was to purchase the AI Mk 17 Radar for all of its 39 Sea Venom FAW Mk 53 Aircraft. Other AI Mk 17 Radars were purchased for operational spares. History ultimately showed that the Royal Air Force only fitted the AI Mk 17 Radar to the first 40 of a total of 436 Gloster Javelin Fighter Aircraft produced, with production having commenced in 1954. Those 40 aircraft were designated as type F(AW) Mk 1

On 23 July, 1951, the Australian Minister for the Navy, Mr William Mahon announced the de Havilland Sea Venom would be ordered for the RAN & the order was subsequently made formal in December, 1951.

The Sea Venom FAW Mk 53 was to be capable of operating in all weather conditions, day or night & so needed Radar equipment to meet this requirement. The design of the RAN’s Venom FAW Mk 53s was basically similar to the Royal Navy’s Venom FAW Mk 21 with the exception of the Radar equipment. The Royal Navy opted for an American Radar – the AN APS 52 equipment.
At the de Havilland Aircraft Factory at Christchurch, Hampshire, the Royal Navy Sea Venom FAW Mk 21 & the Royal Australian Navy FAW Mk 53 were produced concurrently.

The first RAN Sea Venom FAW Mk 53 aircraft became available for fitting of the AI Mk 17 Radar & various trials in the third quarter of 1954.

Initial Technical Training of RAN Personnel in AI Mk 17 Radar
By authority of J.B. Foley, the then RAN Liaison Officer at Australia House, The Strand, London, in March, 1954 arrangements were completed for Sub-Lt(l) J.G.Somervelle & Radio Electrician (Air) J.S.Saywell to undertake 13 weeks of technical training at the Royal Radar Establishment at Malvern & those manufacturers producing the various units comprising the total Radar system.

Sub-Lt(L) J.G. Somervelle & Radio Electrician (Air) J.S.Saywell became integrated into the team introducing the AI Mk 17 Radar equipment into service with the RAF & the RAN. There followed liaison with the various manufacturers to head off potential problems with equipment when in service. Some modifications were introduced, at the manufacturing stage, which improved the reliability of the equipment in service.

The Manufacture of the AI Mk 17 Radar.

The AI Mk 17 Radar system was designated as ARI 5807, where ARI = Air Radio Installation. The Radar system was comprised of a number of units of various sizes which had to fit into any available nook or cranny in an already crammed full aircraft. By breaking the installation down into a number of units made it easier to fit the total equipment into the aircraft. Of course, some pieces of equipment by virtue of their functionality had to be located in set locations, e.g. the Radar antenna, the Observer/Navigator's Radar indicator & the Pilot's Radar-Ranging Gyro Gun sight.

A number of manufacturers were involved in producing the various units comprising the AI Mk 17 Radar System:-

- Metropolitan-Vickers Electrical Co. Ltd., Manchester manufactured the Scanning Unit 122; Servo Amplifier A3706 & the Modulator Unit 301.
- E.M.I.E.D. Ltd, Feltham & E.M.I.Factories Ltd, Wembley manufactured the Transmitter Receiver 3701.
- E.K.Cole Ltd, Malmesbury manufactured the Radar Indicator Unit, Type CRT 100 & Control Units Type 900, 901 & 902, Power Unit 901, the Strobe Unit 100 & the Junction Box 389. At the time they were also carrying out development work on a Gating Unit, 10D/18931 & Power Units 910 & 911.
- Heston Aircraft Ltd, Hounslow were responsible for Radome cooling & various connectors & for Ground Running equipment.
- Wayne Kerr Laboratories Ltd, New Malden produced some test equipment, such as the Scanner & Gyro Simulator 40/9 & Test Set X1440.
- Ferguson Radio Ltd, Enfield manufactured the Gating Unit 10D/18931 & Power Units 910 & 911. They were also doing development work on the Power & Cathode Follower Unit X4503 & Cathode Follower Unit X4504 – the latter units were for operating multiple Radar Indicating Units for the training of Navigators.
- G.E.C.Ltd, Union Works, Wembley manufactured the Performance Testing S Band Resonator Type 101.
- S.G. Brown Ltd, Watford manufactured the Gyro Unit Type 2.

AI Mk17 Radar Brief Technical Details & Operational Aspects

- **Function**: Primarily intended to be used for Air Intercept & Blind Firing against enemy aircraft targets. Additionally, had a search function throughout its full antenna sweep range in azimuth & elevation, so, providing surface target information. Limited sector scans of the antenna could be initiated in particular zones of interest when zeroing in on a target. When locking on to a target aircraft the system antenna produced a conical beam which was used to produce target "up", "down" & "left", "right" information relative to the attacking aircraft flight datum. Target range was derived from the radar & in the final phase of the attack, Radar Range information was fed to the Pilot's Radar–Ranging Gyro Gun sight to correct the gun aiming for range of the target. At this stage of the attack, additionally, a radar target indication was also fed to the Pilot's gunfight via a collimator, enabling the Pilot to engage the target

under blind firing conditions. The radar was controlled at all times by the Observer/Navigator/Radar Operator located to the right of the Pilot. The Observer/Navigator/Radar Operator had access to all Radar control units & monitored target information on the CRT Indicating Unit Type 100. The antenna pointing position was able to be controlled via a joystick controller on the main control unit.

- **Radar Band** : S Band
- **Type of Radar** : Pulsed power microwave transmitter; TR & Anti TR Cells; superheterodyne receiver with klystron local oscillator & crystal diode detector
- **Peak Power** : 250 kilowatts peak power
- **Pulse Length** : < 1 microsecond
- **Pulse Repetition Frequency** : Variable, depending on mode of Radar operation
- **Antenna** : Parabolic reflector with a rotatable waveguide fed offset dipole with a reflector element which produced a conical beam (3 degrees angle between half power points) when in the final lock–on mode. In the search modes the rotatable antenna feed was locked in position with the dipole element in a vertical polarisation position. The antenna dish was controlled by servo motors & had gyro correction signals applied for stabilisation purposes. _

RANSMP at the deHavilland Aircraft Factory.

A Royal Australian Navy Special Maintenance Party (RANSMP) was established at the de Havilland Aircraft Ltd, Christchurch factory to liaise with the Sea Venom FAW Mk53 aircraft manufacturer to head off any potential problems which could arise under actual service conditions. The RANSMP was comprised of a limited number of personnel from a number of disciplines. The Radar & Electrical aspects were covered by Sub Lt (L) J.G.Somervelle & Radio Electrician (Air) J.S.Saywell.
There was also a RNSMP present, at the same time, at de Havilland Aircraft Ltd overseeing the Royal Navy Sea Venom FAW Mk 21 aircraft.

At the de Havilland Aircraft factory, John Saywell had a special monitoring panel built to monitor various parameters of the AI Mk 17 Radar fitted in Sea Venom FAW Mk 53, Serial No., WZ893 during its first test flights The monitor panel was strapped to the Observer's legs, above the knees as there was no where else for it to be placed conveniently! This was going to place an obstacle for the Observer in the event of a "bailout" being necessary in flight! John Saywell was to be the Observer, until Australia House, London heard of what was happening & an immediate ban was put on John Saywell flying as the Observer, "As too much had been invested in Saywell to lose him!" Australia House insisted on a de Havilland personnel to occupy the seat. It wasn't necessary for him to bail out in flight & the equipment came through with flying colours
During the period that the RANSMP was at the deHavilland Aircraft factory deck landing trials were carried out using Sea Venom FAW Mk 53, Serial No., WZ893 fitted with AI Mk17 Radar. The deck landing trials were carried out over a couple of days on board HMS Bulwark off the English south coast. Members of the RANSMP were embarked on board HMS Bulwark for those trials, Sub Lt (L). J.G Somervelle & Chief Radio Electrician (Air) J.S.Saywell covered the Electrical & Radar disciplines during those trials. Commander (L) G.F.E.Knox RAN, who was normally located at Australia House, London was present for the deck landing trials. The AI Mk 17 Radar equipment was physically & functionally checked after each deck landing. There were no problems found during those trials

Proof Testing of AI Mk 17 Radar at RAF Boscombe Down.

RAF Boscombe Down was an Experimental Aircraft Establishment run by the RAF & the British Ministry of Supply where new aircraft types were put through their paces prior to being introduced into service. Boscombe Down was north of Salisbury & not far distant from Stonehenge.

The “Cold War”, between the Western & Eastern Blocs was still running strongly & this was a factor in the new types of aircraft to be sighted at RAF, Boscombe Down in those days!

Sea Venom FAW Mk 53, Serial No., WZ893 arrived at Boscombe Down to be put through its paces & to gain a knowledge of the operational performance of the AI Mk 17 Radar in flight. At this stage we were joined by Lt Commander Gavin Kable RAN who was to be the in flight Observer /Navigator/Radar Operator. The Radar performed well except for ground & sea clutter whilst in flight. This was cured by the use of Radar Absorbent Material (RAM) being fitted to the fibre glass radome which formed the nose of the aircraft. There was some experimentation in arriving at the final pattern of the RAM so that it did not detract from the search performance of the Radar.

“Shooting Trials” using AI Mk17 Radar at 78 Wing RAAF, Takali, Malta G.C.,.

The next phase of proof testing the performance of the AI Mk17 Radar was to operate an aircraft fitted with the Radar intercepting remote controlled target aircraft, firing its guns & evaluating the in flight performance. Those tests were conducted over a period of some weeks in Malta G.C., commencing in the third quarter of 1954.

Getting to Malta G.C. should have been a relative “breeze”, but it turned out to be a saga in itself! A Royal Air Force Douglas DC3 (a Dakota) “workhorse” aircraft had been allocated for the purpose of transporting the trials equipment & personnel from RAF Boscombe Down to Takali, Malta G.C. The DC3 had been prior loaded with its extensive content of trials equipment, including spares to support the testbed aircraft. The personnel were located in any available space amongst the freight! It certainly wasn’t 1st Class or even Business Class, perhaps it was even below Steerage Class, but, that was the way it was done in those days & no one made any comment about the conditions! Takeoff from Boscombe Down was scheduled for 0600 & this was duly achieved – breakfast was scheduled to be taken at RAF Lyneham from where we would be given clearance to depart for an overseas destination. On takeoff, one wheel came up & the other stayed down & refused to come up. The pilot then tried to drop the wheel which had come up but it refused to go down. The pilot next decided that he would try to shake the wheel that was up to go down; this “shaking” exercise consisted of flying the DC3 as though it were a fighter aircraft with violent moves and steep dives with a vigorous pullout from the dive. Thankfully the pilot kept us informed of what he was doing, but it isn’t recommended flying on an empty stomach! The wheel that was “up” stayed where it was throughout all manoeuvres, so finally, the Pilot decided that he had no option except to go in for a crash landing with one wheel up & one wheel down. The next consideration was to use up as much fuel as possible before attempting the landing; this was accomplished after some appreciable time – with a possible breakfast time looking more like lunchtime! With the fuel load being all but depleted it was then into the crash landing phase. On the final approach, the wheel that was up decided to drop down, but lo & behold there was no lock light indicating. Fortunately, the errant wheel was in the lock condition & the landing was completed safely & a late breakfast was enjoyed by those on board. The DC3 was handed over to “maintenance”, with another aircraft being organised to take the Trials Team to Lynham where the DC3 was intended to catch up with the Trials Team. With time marching on & no sign of the DC3 another aircraft was arranged to take the Trials Team to Malta with the DC3 to follow with the Trials Equipment. A stopover was scheduled at

the French Air Force Experimental Base, located near Istre in the south of France. Late in the day the RAF aircraft had UHF radio failure & as the final leg of the flight to Malta was to be at night across the Mediterranean Sea, the aircrew of our transport aircraft decided to return to England & left us at the French airbase near Istre to await the arrival of the DC3 – it arrived in due course. However, it was to be more than a week before we finally departed from Istre! That DC3 aircraft had more problems than one could wish for & we were beginning to believe that we were forgotten people! Fortunately in the Ville D' Istre there was an annual festival in progress & the Trials Team joined in the celebrations with gusto becoming almost honorary citizens. Parts for the DC3 were delivered from England & after a successful test flight the Trials Team once more climbed aboard & we headed for Malta. We didn't get far before there was another magneto failure & due to the aircraft loading, height could not be maintained on one engine! It was back to Istre, barely skimming the stone wall at the end of the runway! Then followed more parts flown from England, more test flights & finally another takeoff for Malta, at night. When quite distant from Istre & at height one engine decided it was time to provide some excitement – the "fireworks" appearing from the exhaust were spectacular! But, with one engine malfunctioning we were losing height & various airfields on Mediterranean islands were placed on alert for a potential emergency landing. The faulty engine finally gave up & we continued for Malta losing height. Finally, we arrived over Malta & reached the Takali Airfield with very little height left & when over the runway threshold the remaining engine realised it was time for it to get into the act & promptly failed, causing us to drop like a brick onto the runway! We had arrived – fortunately in one piece! Note: When the trials were completed the RAF sent a four engined Avro York aircraft to Malta to return the Trials Team to England with the return journey being uneventful! At the time of departure from Malta, the DC3 aircraft was still there, unserviceable!

The location selected for the "shooting" tests was at the Takali airfield, Malta G.C. from which the Royal Australian Air Force 78 Wing was then operating, during a "Middle East Crisis". There was, additionally, a squadron of the Royal Auxiliary Air Force temporarily located at Takali conducting exercises with the Australians. The Australians & their English colleagues were operating in de Havilland Vampire fighter aircraft.

The location in Malta G.C. provided a site with reliable weather & a lot of open space over the Mediterranean Sea in which to conduct the shooting/proof testing trials.
For the trials, the AI Mk17 Radar was installed in a Gloster Meteor NF 11 fighter aircraft & had cameras installed to assess the accuracy of the gun's ammunition, with a liberal mix of tracer shells included, against the target aircraft when being operated with radar information fed to the Radar-Ranging Gyro Gun Sight (GGS). In the initial testing phase the guns were deliberately misaligned, to minimise the cost of target aircraft which were French designed remote radio controlled target aircraft. The Gloster Meteor fighter aircraft Pilot was Polish, having been in the Free Polish Air Force operating in Britain during World War 2 – so, together with a sprinkling of British Ministry Of Supply civilian personnel we had a very International atmosphere about those trials! The shooting trials proceeded smoothly & successfully with each test being analysed fully & were completed over a period of some weeks culminating in a positive demonstration of shooting down a target aircraft under blind firing conditions. It was then time to return to RAF Boscombe Down, England & wind down the "Shooting" Trials Team.

Further testing of the AI Mk 17 Radar System continued at Boscombe Down in the RAF Gloster Meteor aircraft & the RAN Sea Venom Mk 53 FAW Mk 53, Serial No. WZ893 aircraft.

AI Mk 17 Radar Training for RAN 808 Squadron Personnel at RNAS Abbotsinch

The next phase of introducing the AI Mk 17 Radar into the RAN was conducted at the Royal Naval Air Station, Abbotsinch, Scotland (HMS Sanderling). In June, 1955 Chief Radio Electrician (Air) John Saywell proceeded direct from RAF Boscombe Down to RNAS Abbotsinch with a quantity of AI Mk 17 Radar equipment. Other members of the RANSMP who had been at de Havilland aircraft factory, Christchurch, Hampshire had already arrived at RNAS Abbotsinch, awaiting delivery of Sea Venom FAW Mk 53 aircraft & to prepare those aircraft for shipment to Australia on board the new angled flight deck aircraft carrier, HMAS Melbourne.

John Saywell set up the AI Mk 17 Radar System in the RNAS Abbotsinch Radar Workshop in readiness to incorporate late modifications into the equipment & to provide technical training to RAN 808 Squadron Radio personnel who were scheduled to arrive shortly thereafter.

In due course the RAN 808 Squadron personnel were trained in the technicalities of the new AI Mk 17 Radar as well as being trained in the operational functions of the equipment.

The late modifications were successfully completed in all Radar Systems & proved out prior to final installation in each aircraft being prepared for shipment to Australia. Some aircraft had their engines inhibited & those aircraft were cocooned in readiness for long term storage in Australia.

There were a couple of incidents during this stage of work & those were:-

- When a munitions storage facility adjacent to the airfield exploded, killing some civilian staff & causing debris to fall from the Air Radar Workshop ceiling on to the AI Mk 17 Radar equipment & all personnel in the workshop. There was quite some relief when those present realised that they were uninjured!
- At the time, the Irish Republican Army were very active in their campaign against the British & were then currently raiding Military Establishments & in particular targeting, at night, armouries to acquire arms & munitions. The “Powers Who Be” decided that protective action had to be taken at all Military Establishments. At Abbotsinch, all Chief Petty Officers were detailed to provide that protective action in the form of one man, at a time, during the “Silent Hours”, providing a roving patrol with a particular watch on the armoury – they were ordered to inform no one as to what they were doing & provided with a revolver with three rounds of ammunition – in a pouch, with direct orders that under no circumstances was the revolver to be loaded unless they were being shot at when the revolver could be loaded & shoot to kill. John Saywell was detailed off for those patrols & he advised the RN personnel that if they got him killed they would be in a lot of trouble! Australia House, London & the RAN were completely unaware of this activity. The thought did go through John Saywell’s mind, at the time, that in the event of such a confrontation that there was surely only one likely outcome & the odds of success were not going to be stacked in his favour! Years later, John Saywell asked his immediate superior officer, at the time (Lt (L) J.G. Somervelle RAN) if he had been aware of those patrols – he had been completely unaware of the patrols!

AI Mk 17 Radar System Heat Trials in Libya

After RAN 808 Squadron personnel had been provided with technical training by John Saywell at RNAS Abbotsinch there was still one more trials task to complete for the AI Mk 17 Radar System & the Sea Venom FAW Mk 53 aircraft, Serial No. WZ893 & that was the “Heat Trials”. Arrangements had been completed to conduct those trials in Libya. The RAN personnel allocated for

those AI Mk 17 Radar System trials were Lt (L) J.G. Somervelle, Chief Radio Electrician (Air) T.L. Bail & Leading Radio Electrical Mechanic (Air) G. Kelly. The location selected for the Heat Trials was at the International Airport at Idris, near Tripoli in Libya where the RAF had a Detachment. The timing was during the Northern Hemisphere Summer of 1955 & flying days were selected to be completed on days when the temperature was 100 Degrees Fahrenheit or more. The AI Mk 17 Radar System performed correctly during the tests. During those trials the Sea Venom aircraft was flown by a Royal Navy Pilot with the Observer/ Navigator/ Radar Operator being Lt Cdr Gavin Kable RAN.

Setting up the Radar Workshop in HMAS Melbourne

HMAS Melbourne berthed at King George V Dock, Glasgow & embarked the Sea Venom aircraft & RAN personnel from RNAS Abbotsinch, departing for Australia in March, 1956.

During the trip to Australia, Chief Radio Electrician (Air) John Saywell set up the Air Radar Workshop facilities & provided further technical training for Squadron personnel

A couple of incidents occurred on the run to Australia :-

- The first was when HMAS Melbourne was southbound in the Suez Canal & slowed for an approaching Northbound convoy of ships & there was a very strong cross wind blowing. The Melbourne presented a massive “sail area” added to by a mass of aircraft on the flight deck with wings folded upright; the “sail “took over & slewed the Melbourne almost broadside in the canal! There were some hectic moments in regaining control with the stern almost on one bank of the canal! The Captain later addressed the Ship’s Company & stated that one lesson learnt from that exercise was that an aircraft carrier with aircraft parked on the Flight Deck should never consider slowing down for an approaching convoy in the canal!
- The second incident occurred in the Red Sea when there was the alert of “fire below” – a dreaded call! The fire was quickly extinguished & we proceeded to Australia without further incident. .

Setting up the Radar Workshop at RANAS Nowra – HMAS Albatross

In early September, 1956 John Saywell was Drafted from HMAS Melbourne to RANAS, Nowra (HMAS Albatross) & was allocated I/C of the new Air Radar Workshop which was at that time a bare shell building. John Saywell set up this workshop to cope with the maintenance of the Venom Aircraft AI Mk 17 & the Fairey Gannet ASV Mk 19B Radars & provided instruction to technical personnel & to aircrew Observers so that they better understood the operation & capabilities of their equipment.

This completed the introduction of the AI Mk 17 Radar equipment into RAN service.

oooOOOooo

ASV Mk 19B

By Chris Poole

ASV Mk 19B grew out of an immediate post war (1945- 46) TRE/Ekco (note 1) research program to investigate the feasibility of Cloud and Collision Warning Radar (CCWR), the result of which was the Ekco E34 search radar set.

By the end of WW2 it had become woefully apparent that there was a need to have a new ‘fleet’ Anti submarine aircraft since the Fairey Firefly, which had been converted to this role, was showing that there was very little design

development left in the airframe and it was also suffering from ‘wartime’ era radar. This led to the Admiralty issuing specification GR.17/45 for a new aircraft which would have an ASV role, have 2 engines, be capable of carrying a range of weapons and have a Radar suite which could be capable of detecting submarine snorkels and periscopes in various sea states. The result of this was the Fairey type Q which became the Fairey Gannet.

Since TRE were already working with Ekco on CCWR and knew of the potential of the E34, this Radar was developed into the Ekco Type E38, which was to all intents and purposes ASV-19. The original design concept was for a ‘POD’ Radar to be fitted under the starboard wing (similar to the American Gruman Avenger TBM-3) and this dictated that the Radar had a conventional scanner unit with a 150 degree azimuth sweep. This Radar was the ASV Mk 19A.

Since the Gannet was late in service, in 1953 the Royal Navy/FAA acquired an undetermined number of Gruman anti-submarine warfare versions of the Avengers in 1953 under the Mutual Defence Assistance Program (MDAP). These aircraft were designated the ***Avenger AS Mk IV*** or ***AS Mk V***, and were used in the ASW role until the introduction of the Gannet in 1955. In these aircraft the American Radar was removed and replaced with ASV Mk 19A. In conjunction with this, a T1 variant of Percival Sea Prince was produced to act as a flying classroom where the ASV 19 was conventionally mounted in the nose, and with 3 scopes fitted on workstations in the cockpit so that 3 Radar Operators/Observers could be trained at any one time.

The Gannet evolved with a retractable dustbin Radar suite, hence the need to redesign the scanner and indicator unit, which became ASV Mk 19B.It is fairly certain that these units were made under a separate contract with EMI, using similar design principles to H2S units.

Note 1. TRE is Telecommunications Research Institute, and was later named RRE, Radar Research Establishment. Ekco was the trade name for E.K.Cole Ltd. The Radar/Telecom section set up in 1952 as a separate division called EKCO Electronics Limited.

Editor’s note: More information about the development of the ASV Mk 19B may be obtained from www.ekco-radar.co.uk/ASV19/asv.php. As well, the author of this article has published a further article about the development of Radar and WW2. This can be viewed on http://www.malmesbury-memories.co.uk/wartimeindex1.html.

Following is a copy of the full service report of ASV Mk 19B, classified as SECRET until 2002, submtted by Mr Chris Poole.

SERVICE TRIALS UNIT

R.N. AIR STATION

FORD

SUSSEX

SECRET

Report Number 509/52 Preliminary Performance Assessment of

A.S.V. Mark 19B

Date: - 12th February 1952

DISTRIBUTION

Requested on form 101: -

Admiralty	
B.A.W.	13 copies
D.R.E.	6 copies
D.N.D.R.	1 copy
D.N.L.D.	1 copy
D.A.C.T.	1 copy
Ministry of Supply	
N.A./D.C.D.	4 COPIES
Flag Officer; Air (Home)	3 copies
The Director, R.A.E. Farnborough	1 copy
Telecommunications Research Establishment Malvern	2 copies
Admiralty Signal and Radar Establishment Haslemere	1 copy
Equipment and Trials Section, H.M.S. 'Aerial'	1 copy
Telecommunications Flying Unit, Defford	1 copy

1. INTRODUCTION.

(a) Authorisation.

Trial number 533/Misc/182 was authorised by Flag Officer, Air (Home)'s form 101 number 1545/579F/460 dated 24th May 1951, which was accompanied by a questionnaire and by Admiralty letter A/AWD/401/50 of 7th May 1951.

(b) Officers concerned.

Lieutenant Commander G.T. Turner R.N.	Observer.
Mr G.L. Holmes – Commissioned Observer R.N.	
Lieutenant G. Dunworth R.N.	Pilot.
Lieutenant (L) K. Lobb R.N.	Electrical Officer.

(c) Sorties and Flying Times.

Lieut. Cdr. Turner	6 sorties	11 hrs. 50 mins.
Mr G.L. Holmes	26 sorties	44 hrs. 40 mins.

Total 32 sorties 56 hrs. 30 mins.

(d) Previous reports.

An interim report, number 507/51, was issued on this equipment on the 31st December 1951.

A previous report, number 511/50, on the commercial predecessor of this equipment, was issued on the 31st July 1950.

2. OBJECT OF THE TRIAL

The object of the trials is the preliminary performance assessment of the equipment before the full Service trials, with particular reference to the suitability of the scanner, indicators and the control unit.

3. DESCRIPTION OF THE EQUIPMENT

A.S.V. 19B radar equipment has been adapted from the cloud and collision warning equipment manufactured by E.K.Cole Ltd. preliminary service trials of which were carried out by an observer from this unit between 17th and 25th July 1950.

The major differences between the original and this equipment are the provision of one larger indicator using a six- inch cathode ray tube and the use of scanner X 432. The set now provides: -

i. P.P.I. on 10 and on 40-mile ranges.

ii. An open centre control on the 10-mile range to give more accurate bearing indication at short ranges.

iii. Range markers, which appear as concentric circles every 2 miles on the 10-mile range and every 5 miles on the 40-mile range. A marker on/off switch and brilliance control has been provided for these trials but it is understood that the on/off switch will be deleted from future equipments.

iv. Scanner stabilisation in roll and pitch, and tilt control of the 6-degree beam between 5 degrees up and 10 degrees down.

4. CONDUCT OF THE TRIAL

One flight with this equipment was carried out on 5th. September 1951, after which the equipment required servicing,

Five sorties were carried cut in the Portland area between 2nd. and 5th. October, with very promising results, after which the equipment again became unserviceable and the aircraft returned to Defford,

The aircraft returned to R.N. Air Station, Ford, on 23rd. October, and one sortie was carried out. Ranges obtained were low compared with those obtained in similar conditions between 2nd. and 5th. October, and the presentation was generally jittery end unstable. The aircraft therefore returned to Defford for further servicing of the equipment by the Telecommunications Research Establishment Malvern.

An observer from this Unit was detached to the Telecommunications Flying Unit, Defford, on the 20th November in an effort to speed up the trial. The excessive jitter had been cleared in the main by this date by T.R.E. but several other faults were still apparent, and much work: and many test flights were carried out before the equipment was judged to be fully serviceable on 29th, November.

The -aircraft was detached to R.A.F. Station, St Mawgan, on the 28th November to progress comparative trials with A.S.V. 13 installed in Shackleton aircraft (A.S.W.D.U. TRIAL 311 - 'Caster and Pollux'). The target used during this trial period was the trellis-topped international marker buoy off Godrevy Island. and ranges obtained compared favourably with ranges obtained by ASV-13 on the same target at the same time, but it was subsequently shown that all these ranges were below average. The Anson therefore returned to Defford and the trial was stopped until units that had been overhauled by the contractors became available. These units (the transmitter receiver, synchroniser and control unit) were installed and the aircraft returned to St. Mawgan by 6th December 1951. The general performance of the equipment, particularly the A.F.C. and the Tilt systems, was below the required standard and results, although much the same as those of the previous week, were disappointing compared to those obtained by ASV-13 in Shackleton's.

The aircraft returned to T.F.U. Defford on the 14th December and the radar equipment, together with the non-airworthy set used for bench testing by T.F.U. Defford was returned to T.R.E. The transmitter-receiver from the aircraft was returned to the contractors on 31st December for further investigation.

R.N. Air Station Ford was closed for the Christmas leave period from 18th December until 3rd January 1952.

An observer from the Service Trials Unit was lent to T.F.U. Defford on the 7th January to progress the trial and at the request of T.R.E. Malvern, an officer from the equipment and Trials section H.M.S. Ariel. Further very willing co-operation was forthcoming from Messer's. Gard and Oxborough from E.K. Cole Limited and a considerable amount of work was completed by this team during the period 7th to 14th January.

As no Shackletons were available from A.S.W.D.U. for the comparative trial between ASV 19B and 13, it was decided to continue operating from Defford to facilitate servicing of both the equipment and of the aircraft, and a total of 10 hours 40 minutes flying was completed against various targets in the Bristol Channel.

During this period the weather was consistently bad, and on the 9th January the radome was damaged when the aircraft flew through a violent hailstorm for about 30 seconds. Photographs of the damage and a technical appreciation are included under the maintenance section of this report (Missing). The equipment itself continued to give complete satisfaction.

It was expected that further progress could be made on the comparative trial with ASV 13 at St. Mawgan, so the Anson left Defford for St. Mawgan on the 21st January 1952. Unfortunately unserviceability prevented Shackleton co-operation throughout the week; one combined operation was attempted but the Shackleton was forced to return to base by engine failure after two runs on the target. Anson VM 306 continued to operate in the area, and during the period 21st to 25th January the equipment operated satisfactorily against a wide variety of targets, including the marker buoy off Godrevy Island.

Results were good and compared favourably with the majority of those obtained by ASV 13 on previous occasions, but due to the unserviceability of the Shackletons the S.T.U. observer had no opportunity to operate ASV 13 and so give a more realistic comparison.

A second transmitter-receiver unit, brought as a spare was tried during the week to check that the modifications carried out by the contractor had cured the previous A.F.C. faults. This was proved, and the results obtained were comparable with the other, but it could not be used due to the recurrence of range marker jitter. This is an old fault known by the contractors, and subsequent T.R. Boxes have been suitably modified to prevent its recurrence.

5. OPERATIONAL PERFORMANCE

(a) Maximum Range

Detailed figures of the detection ranges against various types of targets are given in the appendices.

Since the scanner was positioned in the nose of Anson VM 306, only forward looking was possible; the fuselage effectively blanked all echo's from approximately 10 degrees aft each way.

Two ranges are quoted in the appendices and are classified as: -

I. Detection range

The range at which a target could be detected if its approximate relative position were known. At such a range, painting occurs once every three or four scans, and would possibly be missed by an operator doing an all round scan

II. Tracking range

The range at which a reasonably consistent painting occurs, and at which there is little possibility of an operator missing the 'blip'

(b) Target discrimination

Target discrimination is considered to be adequate for all normal A.S.V. search requirements. Two examples are given: -

I. The Scilly Islands, which first appeared as a single echo at 35 to 37 miles, split into five clearly recognisable groups at 25 miles – approach course 260 degrees true.

II. A large tanker steaming a half to one mile offshore on a course parallel to the coast was clearly identified as a single echo when stern on at a range of 25 miles.

(c) Accuracy of ranges and bearings.

The cursors supplied for this trial were marked with 30 degree/bearing lines only, and were made adjustable vertically and horizontally, so that a reasonable compromise in centring the trace could be made between the two indictors, which have common X and Y plate shift controls.

No inspection of the scanner was possible without removing the radome, so the cursor had to be lined up to the ahead position by inspection of the trace itself, which is not an accurate method. In addition, the bolts securing the cursor served

also as securing studs for the visor, and it was possible to involuntarily alter the position of the cursor each time the visor was shipped or unshipped. The cursors when mounted were too far from the face of the tube, which gave rise to considerable parallax errors.

5 (c) continued

It was found that it was impossible to estimate correctly the bearing of any target on the 40-mile range due to the above inaccuracies, but on the 10-mile range these faults were not so apparent. It was found that all targets could be tracked very accurately down the 'on top' position.

Accuracy of range estimation depends almost entirely on the accuracy with which the range marker circuit is set up. No errors were found at any time when comparing radar ranges with those from maps and charts, and the changeover of ranges from the 40-mile to the 10-mile range produced no inaccuracies.

(d) The effect of sea clutter

If the target can be picked up outside the range of sea returns, it can be tracked to the zero range for that height. An experienced operator can also do this if the target is detected up to two miles inside the extent of sea returns. It must be emphasised, however that in both cases considerable experience is required to achieve this on a small target since it requires critical manipulation of 'tilt', 'gain' and 'brilliance' controls, and possibly the use of the sea clutter filter.

The sea clutter filter as originally fitted was found to be much too fierce and was virtually useless when it was most required, homing on small targets in conditions of heavy sea returns. A service modification was carried out on the filter fitted to the rear indicator with a fair degree of success, but due to the high sensitivity of the receiver and the consequent rise in amplitude and extent of sea returns, investigation into the provision of an efficient sea clutter filter is still outstanding.

(e) Minimum range

Minimum range due to height, which were reasonably consistent in sea states of up to 4 were found to be as follows: -

2,000 feet	1 ¾ miles
1,000 feet	1 mile
500 feet	¼ mile
200 feet	zero

In sea states of 5 to 6 these minimum ranges were increased by approximately ¼ mile, but in these conditions zero range could always be reached if the height was reduced to 200 feet. No sea states greater than 6 were experienced throughout the trial.

6. MAINTENANCE

(a) General

At the start of the trial it was not expected that much new or conclusive information bearing on service maintenance would be obtained, for the following reasons: -

i. The transmitter-receiver, synchroniser (with its front panel serving as a junction box), servo-amplifier and controller were of the early cloud and collision warning radar series, of which fair experience had already been

gained in previous Anson and Firefly installations and on the bench. Previous comments on these units are well known, and are catered for in the production ASV 19B series.

ii. The indicators fitted were also of the original type, one fitted with a CV 1530 cathode ray tube (a six inch tube using the same electrical circuits) and the other with a lens to give a magnified presentation, both indicators being modified to include individual control of range marker intensity and a sea clutter filter as used in ASV 15. The larger tube has been adopted for ASV 19B, but no fully engineered model was available for the trial.

iii. The scanner X 432 was the first experimental model with many known defects, which will not be present in subsequent models.

iv. The aircraft was to be based at Defford, where any aircraft maintenance required would be carried out, while the responsibility for radar maintenance was to be that of T.R.E.

v. No airworthy replacement units were available in case of failure, and test equipment for the first line use was limited to a Monitor X 469, an echo box TS 62 and a Monitor 52, which was permanently installed in the aircraft.

It was accordingly decided to allocate one Radio Electrician (Air) to this project, liaison at office level being carried out at Defford and T.R.E. during any necessary maintenance or modification work.

(b) Narrative

First Phase – 1st October to 30th November 1951

1st Oct. The equipment was satisfactorily flight tested and flown to R.N.A.S. Ford.

2nd-4th Oct. Equipment operated satisfactorily.

5th Oct. The aircraft was returned to Defford as the gyro unit failed to erect. This was removed and subsequently returned to R.A.E. for investigation, a Control Unit type 512 being fitted for the remainder of the trial.

9th Oct. The aircraft returned to Ford.

10-16th Oct. The aircraft was unserviceable due to airframe damage. The following faults developed on the ASV installation.

i. Open circuit video lead to the second indicator

ii. Faulty time base valve (CV 138) in the synchroniser

iii. A slight time base jitter developed, but was not traced.

Note: During this time servicing was attempted by two Radio Electricians (Air) and by an Experimental Officer from T.R.E., but conditions were very unsuitable as there were no spare parts, no bench facilities and the units in the aircraft were not easily accessible.

17-18th Oct. The slight jitter was accepted, the equipment otherwise serviceable.

19-20th Oct. The aircraft was returned to Defford for engine maintenance

23rd Oct. The aircraft and radar were serviceable and were flown to ford, where ranges obtained were poor

24-26th Oct. The aircraft returned to Defford where a performance check was carried out, the Transmitter-receiver re-aligned, a new crystal (CV 253) fitted, and the I.F. Strip checked at T.R.E. An improvement in performance resulted, and a tendency to overload tripping was traced to too high an output voltage from the motor generator type 4B. This was rectified.

29th Oct. 7th Nov A serious attempt was made to locate the origin of the time base jitter, the following contributory causes being found: -

i. Poorly fitting valve holders in the synchroniser giving intermittent contact with vibration.
ii. Vibration arising from an unbalanced blower motor fan in the synchroniser.
iii. Microphonic valve, paraphrase amplifier (VC 138) in the synchroniser.

During this period connector faults developed giving loss of signal crystal current and three phase voltages. These faults were rectified.

Maintenance Cont.

8-23rd Nov. During this period it was confirmed that the R.F. performance was satisfactory, but the loss in overall performance was due to poor operation of the A.F.C. circuit, which was subject to intermittent fast fluctuation, the cause of which could not be traced. During this period and later, less T.R.E. effort could be made available as the trial and its attendant investigations were lasting longer than had been anticipated. A service modification, increasing a condensor value, was made to the second indicator to make the sea clutter filter less fierce in operation. A limiting crystal diode (CV 448) failed in the first indicator, but this circuit will not be included in the final version of the indicator.

27-29th Nov. The aircraft operated from St. Mawgan, but the level of performance reached in early October was not attained.

Second phase – 30th November to 31st. December 1951

30th Nov. At a progress meeting at the contractors, E.K. Cole Ltd., it was decided to suspend the trial until and overhauled system, less the scanner, could be provided by the contractor, to be on loan for the remainder of the trial.

4-5th Dec. The replacement transmitter-receiver, synchroniser and controller were installed and accepted by T.R.E.

6-7th Dec. The aircraft operated from St. Mawgan, but the general performance and the A.F.C. circuit were still not up to the required standard.

10-17th Dec. Ditto

31st Dec. The Transmitter-receiver was returned to the contractor for investigation.

Third phase – 3rd January to 28th January 1952

3rd Jan. At the ASV 19 progress meeting it was agreed that the trial should be brought to a conclusion as soon as possible and that the contractor should be invited to fly with the system to assess its

performance, in an endeavour to clear up the A.F.C. troubles. At T.R.E. request the technical co-ordination for the remainder of the trial was undertaken by the Air Officer of the Equipment and Trials Section, H.M.S. 'Ariel' working direct with the contractor as necessary.

7-8th Jan. Measurements of S.W.R. and frequency pulling were made on the installation to prove that the A.F.C. variations were not due to imperfections in the Waveguide run or scanner. The results were uniform and of a high order.

9-11th Jan. The following modifications were carried out by the contractor: -

i. The A.F.C. circuit in the transmitter-receiver was modified to include damping resisters of 1K across L201 and L202, reducing the gain and giving better lock-on discrimination between the I.F. and the second harmonic of half the I.F.

ii. The synchroniser was modified to improve range marker intensity by increasing C26 to 68pf and to reshape the bright-up reducing intense brilliance at the centre of the indicator, by increasing R61 to 100K.

Subsequent ground and air testing disclosed the following: -

i. Connector faults had developed leading to the loss of three phase supplies and the loss of the horizontal deflections to the second indicator.

ii. Stabilisation was inoperative, and the control unit type 512, which had become very stiff to cage and un-cage was replaced. The faulty unit was later lubricated and worked satisfactorily. Tests were carried out on the servo system using dummy gyros, and its operation adjusted to give oversawing for 5 degrees displacement, instead of 10 degrees as previously aligned. This was done to improve stabilisation, which was sluggish in rough air.

9-11th Jan.Cont.

iii. The A.F.C. was intermittent in operation and Klystron voltages were abnormal, a subsequent investigation by the contractors disclosing an intermittent heater-cathode short circuit in the discriminator, CV 140.

iv. The R.F. performance was poor, and was found to be due to a low power magnetron, CV 370.

14-15th Jan. The installation functioned well, the performance being as good as that experienced at the beginning of the trials.

16th Jan. Repairs were carried out on the radome, which had been damaged by hail on the 9th January. Small patches of neoprene had flaked off, and the exposed laminate there-upon 'blistered'.

17-18th Jan Radar performance was good.

21-25th Jan The aircraft operated from St. Mawgan, the general performance being good, although at the end of this period there were equipment warning peculiarities (the absence of open centre, a short double-sided trace on the 40 mile range and an intermittent firing of the transmitter). These faults were repeated at the contractors on the 28th January, and were found to be due to low input voltages. The power supplies to be used for Gannet AS Mk1 will include an inverter type 202 with a thyraton control unit, giving 115v single phase supply controlled in voltage and frequency to

close tolerances. A spare transmitter-receiver and synchroniser were borrowed from T.R.E. for this period and modified to the same standard as the aircraft system. The transmitter-receiver was tried in the aircraft in order to obtain a comparison but it produced woolly marker rings on the 10-mile range and was not flown. This fault was referred to the contractors, who had experienced it before in certain units. It is due to prepulse generator instability, and will not occur in production units.

(c) Remarks on individual Units

As has already been indicated, the experimental nature of the installation and the fact that it was not until the final phase of the trail that maintenance was under the direct control of the services do not allow fair answers to be made to the questionnaire, nor conclusions to be drawn from them. The following points did, however arise.

i. Stabilisation System.

(a) A marked improvement resulted after increasing the signal Vs feedback ratio in the servo-amplifier to give one overswing for 5 degrees displacement. However the scanner did not appear to move smoothly, but in a series of steps. The system is not difficult to set up in the aircraft.

(b) Insufficient experience was gained of the gyro unit type 5, as a control unit type 512 was in use for most of the trial.

ii. Tilt System.

A makeshift tilt system was in use, which was unstable and its relays gave ‘splash’ on the display.

iii. Scanner.

Full comment cannot be made on this early model, but sub-units are incorporated for ease of servicing. A directive feed was incorporated in the Waveguide run.

Maintenance Cont.

iv. Indicators.

No comment can be made on the layout or accessibility. The tube in use CV 1530D, although an improved version of the early CV 1530, is still subject to electrostatic defects such as accelerator shadow, which if not appreciated lead to a distorted display. It is desirable to set brilliance to maximum during the warm up time to overcome this.

(d) Test Equipment.

In general the test equipment should be similar to that of ASV 19A with the addition of a small number of items peculiar to the scanner and stabilisation system.

7. CONCLUSIONS AND RECOMMENDATIONS.

(a) <u>General</u>

After a promising start to the trial in October 1951, considerable delay was experienced due to unserviceability. It is felt that this delay could have been greatly reduced if more continuity had been available in the day to day servicing of the equipment, and if the contractors had been approached earlier. Such action was pressed by the service representatives at T.R.E.. Continuity was only achieved when an officer from the equipment and trials section, H.M.S. 'Ariel' assumed responsibility for the technical co-ordination of the trial. When the contractors were invited to fly with the equipment the two major faults were investigated and rectification action taken within a week. The equipment subsequently flew for approximately 20 hours in 14 days without further adjustment.

From an equipment point of view the main advantage obtained from this trial was the investigation into the A.F.C. unit and its subsequent modification to give a more reliable performance facilitating alignment.

(b) <u>The stabilisation System.</u>

This has been improved by the adjustments detailed in the maintenance section of this report, but movement in both pitch and roll is still jerky. The effect of this operation operationally is that in turbulent flying conditions large sectors of the scan are missed as the aircraft rolls and pitches. It is realised that the type of aircraft to be fitted with ASV 19B will not be affected so violently by such conditions as an Anson, and for this reason this system is considered to be adequate if the fault cannot be cured without delay.

(c) <u>The Tilt System.</u>

The tilt system has given considerable trouble, but critismns of it are well know by T.R.E., who gave assurances that the faults experienced during this trial will not be repeated in later models of the scanner. These faults have been: -

(a) If the tilt was set at 5 degrees or above, the scanner could not be returned to horizontal except by breaking the scanner On/Off switch and inching the scanner while slowly moving the control towards zero. The higher positive tilt settings were therefore blanked off and will be deleted from future models.

(b) Excessive jitter occurred when the control was moved in a negative direction. This jitter, sometimes accompanied by time-base splash, steadily worsened as the trial progressed. To reach a given tilt setting of , say minus 4 degrees, it was necessary to move the tilt control to minus 7 degrees and then return to the required setting in a positive direction.

(c) Control of tilt is sluggish, and it is felt that the general operational usefulness of the equipment would be enhanced if the tilt follow-up could be speeded up. It is, however, acceptable if this is likely to involve major modification action and the consequent delay in production.

(d) <u>The Indicator Units.</u>

Two indicators were fitted in this installation, a six-inch high intensity low persistence green tube, and a smaller medium intensity medium persistence orange tube fitted with a magnifier. Both tubes used the same electrical circuits, and had only one minor fault throughout the trial. The large tube has been adopted for ASV 19B but no fully engineered model was available for the trial. The following remarks are therefore made for completeness only.

i. The magnifier on the small tube was most effective, and in fact one of the two operators preferred the medium persistence amber colour as being more restful, while giving detection ranges comparable with the high intensity green tube. It is therefore recommended that both types of tube be used for the full service trials of the equipment.

ii. During the latter stages of the trial an amber filter was made locally and fitted to the main green, indicator. It proved most effective in reducing glare. It is felt by the operator concerned that the cursor itself could well be made of this colour, but as experience was limited to one operator it is recommended that both clear and amber cursors be supplied as alternative fittings for the full service trial.

iii. It is considered that the cursors supplied for this trial were positioned too far from the tube, which gave rise to excessive parallax error.

iv. It is recommended that the method of securing the cursors and visors be improved, since the act of fixing the visor to the indicator in the present method tends to move the cursor off alignment. The problem might be solved by locating the visor with securing studs athwartships. As present these studs secure both cursor and visor.

v. It has been recommended to T.R.E. that additional half inch lines be engraved around the circumference of the cursor to aid bearing estimation of distant targets for plotting purposes, and the cursors supplied for the full service trials will be so engraved.

(e) Visors.

The visors supplied for this trial are considered to be adequate, with the following provisions:-

i. The inside of the visor should be finished in dull black. The operators have been seriously affected by the extreme glare reflected from the inner walls of the indicator. This reflection was partly reduced when the amber filter, mentioned in Para. (d) (ii) above, was used, but was still in existence.

ii. Every effort should be made to achieve as close a fit as possible between and the visor and the front face of the indicator. This fault is not readily apparent in the Anson aircraft, which is conveniently fitted with sunblinds, but can be very troublesome in an aircraft not so fitted.

(f) The Control Unit.

This differs considerably in layout from the production version, and therefore only general recommendations can be made.

i. The scanner On/Off switch should be retained in the production version to enable the scanner to be stopped in order to facilitate tuning and comparison of video strengths when estimating optimum tilt settings for various heights.

ii. The size and shape of the controls most often used is considered to be of equal importance to their relative position on the Control Unit. It is therefore recommended that the operational controls, which are the gain, brilliance, tilt and sea clutter filter controls, should be of such shape and size and be so positioned that they can be readily identified by touch. This is an essential requirement.

iii. It is further recommended that the focus control be placed away from those mentioned above. Time is sometimes lost at a critical stage of a homing if this control is moved inadvertently.

(g) Installation.

The following recommendations are made with particular application to the installation of ASV 19B in an Anson aircraft for full service trials, but recommendation (i) applies generally.

i. The installation should be laid out in accordance with service representatives, to make easy access to the following components: -

(a) The Gyro Unit, in case a control unit type 512 has to be used, which requires caging and un-caging in flight.

(b) The front of the transmitter-receiver and the directive feed.

(c) The junction box, the front of the servo-amplifier, and the synchroniser.

Generally speaking it is desirable to have to remove one or more units in order to reach another.

ii. Two complete sets of units produced to ASV 19B standards should be used, with a fully engineered scanner.

iii. A new radome will be required (after the damage to the original one) and an access panel to the scanner components should be incorporated inside the aircraft to facilitate alignment of the servo system and the indicators.

iv. The radar primary supplies should conform to those used in Navel aircraft.

v. The intercommunication system should be modified to the users requirements.

vi. Test equipment to enable a daily assessment of performance to be made should be provided.

Signed

Lieutenant Commander R.N.
A/Commanding Officer
Service Trials Unit.